

## AM-Receiver

### Description

The U4240B is a bipolar integrated AM receiver circuit. It performs all the active functions and part of the filtering

required of the AM radio receiver. The device is designed for car radio and home receiver applications.

### Features

- ESD protected
- IF output for stereo demodulator and stop signal generation
- AF preamplifier with simple filtering
- Controlled RF preamplifier
- Double balanced mixer
- Separate oscillator with amplitude control
- IF amplifier with gain control
- Balanced full-wave detector
- Audio preamplifier
- Internal AGC voltage
- Amplifier for field-strength indication
- Electronic standby ON/ OFF switch

### Block Diagram

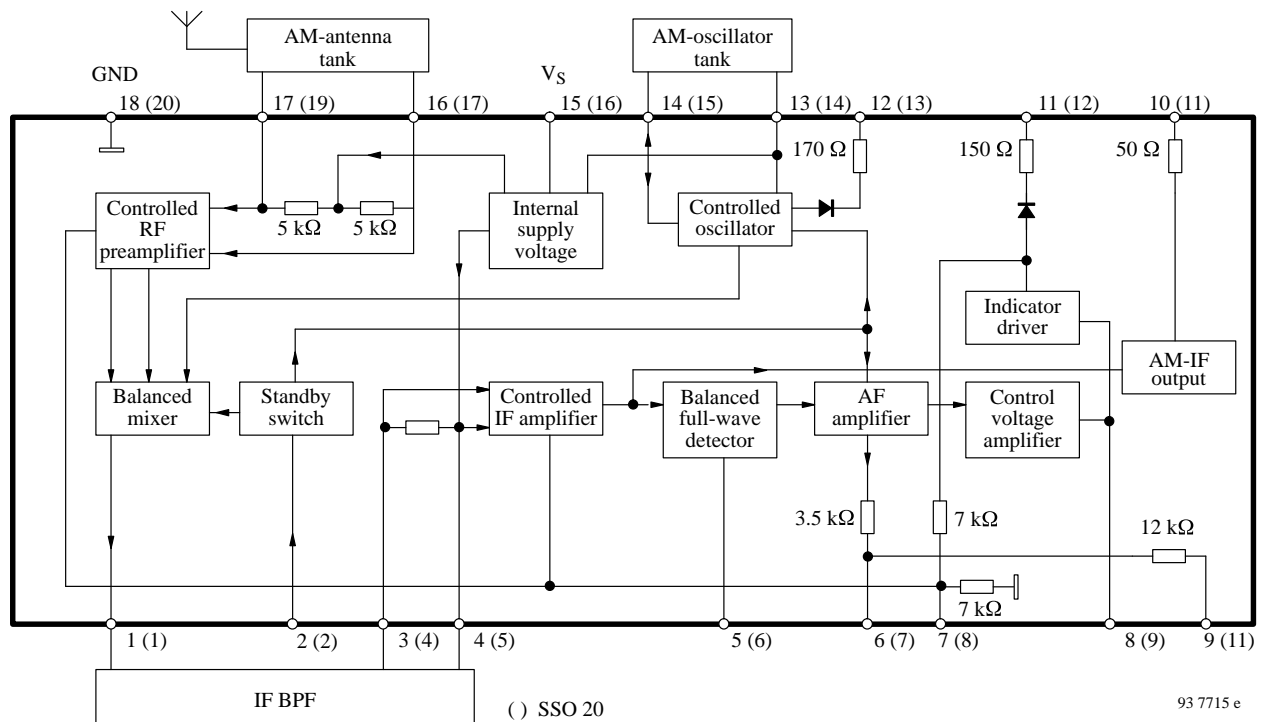
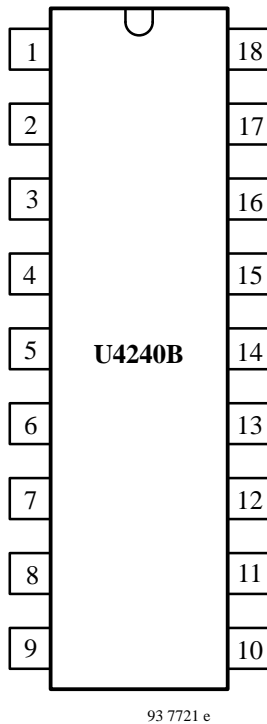


Figure 1.

## Pin Description



DIP 18	DIP 20	Function
1	1	Mixer output
2	2	Standby switch
3	4	IF amplifier input
4	5	V <sub>REF</sub>
5	6	Low pass filtering
6	7	AF output
7, 8	8, 9	AGC time constant
9	10	Low pass filtered AF output
10	11	IF output
11	12	Field strength indicator
12	13	Oscillator output
13	14	Oscillator tank reference output
14	15	Oscillator tank input
15	16	V <sub>S</sub>
16, 17	17, 19	RF input
18	20	GND
	3, 18	Not connected

### Controlled RF Preamplifier, Pin 7

The RF preamplifier is built up differentially in order to achieve the best possible large signal handling capability. Special care was taken to reduce the input stage noise.

### Balanced Mixer, Pin 1

The mixer is a double balanced type with a single ended output.

### Controlled Oscillator, Pins 13 and 14

The oscillator employs temperature compensation, simple varicap and coil connection. The amplitude of the oscillator is controlled to low values, in order to support AM varactor diodes. The LO-buffer supports the U428xBM PLL-family.

### Controlled IF Amplifier, Pin 3

The IF amplifier consists of two controlled gain cells coupled by capacitive means. Internal band pass filtering reduces higher order products and THD.

### AM-IF Output, Pin 10

For AM stereo application and for stop signal generation by IF counting Pin 10 provides a non limited but amplitude controlled IF signal of about 280 mV.

### Balanced Full-Wave Detector, Pin 5

The detector consists of a Gilbert cell that multiplies the limited carrier signal with the IF output signal and therefore employs a full wave rectification. Second or higher order products at the output are internally low pass filtered.

### AF Amplifier, Pin 6

The AF amplifier has two different outputs. They provide different output resistances for simplifying applications. For a high end application Pin 6 provides a 3.5 k $\Omega$  output resistor to support a second order low pass filter. Pin 9 provides additional 12 k $\Omega$  for a simple first order low pass filter.

### AGC, Pin 8

The AGC block generates the AGC voltage that is to be smoothed at Pin 8. The capacitor at Pin 8 defines the time constant. The voltage at Pin 8 is buffered to control the internal gain stages with different delay. The control voltage is available at Pin 11 (field strength indication).

### Standby Switch, Pin 2

The whole circuit can be powered down by the standby switch. This mode can be achieved by a dc voltage higher than 3.5 V at Pin 2.

## Absolute Maximum Ratings

Reference point Pin 18, unless otherwise specified

Parameters	Symbol	Value	Unit
Supply voltage Pin 15	$V_S$	12	V
Input voltage Pin 2	$V_2$	12	V
Pins 16 and 17	$IV_{16-17I}$	12	
Pins 16 and 17	$V_{16}, V_{17}$	VS	
Input current Pins 16 and 17	$I_{16}, I_{17}$	200	mA
Ambient temperature range	$T_{amb}$	-30 to +85	°C
Storage temperature range	$T_{stg}$	-55 to +150	°C
Junction temperature	$T_j$	125	°C
Electrostatic handling (MIL Standard 883 C) except Pin 10	$\pm V_{ESD}$	2000	V

## Thermal Resistance

Parameters	Symbol	Value	Unit
Junction ambient	$R_{thJA}$	100	K/W

## Electrical Characteristics

 $V_S = 8.5$  V, reference point Pin 18,  $f_{iRF} = 1$  MHz,  $R_G = 50$   $\Omega$ ,  $f_{mod} = 0.4$  kHz,  $m = 30\%$ ,  $f_{IF} = 460$  kHz,  $T_{amb} = 25$ °C, unless otherwise specified

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
<b>Supply</b>						
<b>Pin 15</b>						
Supply voltage		$V_S$	7.5		12	V
Supply current	without load: $I_L = 0$ (Pin 13)	$I_S$		23	30	mA
<b>RF preamplifier</b>						
DC input voltages	Pins 16 and 17	$V_i$		$V_S/2$		V
Input impedance	$V_{iRF} < 300$ $\mu$ V, Pins 16, 17	$R_i$		5.5		k $\Omega$
		$C_i$		25		pF
	$V_{iRF} > 10$ mV Pins 16, 17	$R_i$		80		k $\Omega$
		$C_i$		22		pF
Maximum RF input voltage	Pins 16 and 17	$V_i$		2.5		$V_{pp}$
<b>Mixer output</b>						
<b>Pin 1</b>						
Output impedance		$R_o$	500			k $\Omega$
		$C_o$		6.0		pF
Conversion conductance	$I_{oIF}/V_{iRF}$	$S_M$			6.5	mA/V
<b>Oscillator</b>						
Frequency range	Pin 14	$f_{osc}$	0.6		60	MHz
Oscillator circuit impedance range	Pin 14	$Z_{Losc}$	0.5		200	k $\Omega$
Controlled oscillator amplitude	Pin 14	$V_{osc}$		130	160	mV
DC output voltage	$I_L = 0$ Pin 13	$V_o$		6 $V_{BE}$ (4.2V)		V
Output load current range	Pin 13	$-I_l$	0		20	mA

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
<b>Oscillator frequency output, <math>R_{L10} = 2.2 \text{ k}\Omega</math> Pin 12</b>						
Output voltage		$V_O$		320		$\text{mV}_{pp}$
DC output voltage		$V_O$		0.9		V
Output resistance		$R_O$		170		$\Omega$
Output current		$I_O$			3	$\text{mA}_p$
<b>IF amplifier and demodulator</b>						
DC input voltages	Pins 3 and 4	$V_i$		2		V
Input impedance	Pins 3	$R_i$	2.4	3	3.9	$\text{k}\Omega$
		$C_i$		7		pF
Maximum IF input voltage	$m = 80\%$ , $d = 3\%$ , Pin 3	$V_i$		55		mV
IF output voltage, without load	$V_i = 10 \text{ mV}$ (Pin 3/4) Pin 10	$V_o$	230	280	340	mV
IF output resistance	Pin 10	$R_o$		50		$\Omega$
Control range	$\Delta V_{oAF} = 6 \text{ dB}$	$\Delta V_i$		50		dB
Audio output voltage, without load	$V_i = 1 \text{ mV}$ (Pin 3/4) Pins 6 and 9	$V_o$		310		mV
Audio output resistance	Pin 6	$R_o$	2.9	3.5	4.2	$\text{k}\Omega$
	Pin 9		9	12	15	
<b>Field strength indication Pin 11</b>						
DC indicator voltages	$R_{L11} = 2.7 \text{ k}\Omega$ , $V_i = 0$ $R_{L11} = 2.7 \text{ k}\Omega$ , $V_i = 500 \text{ mV}$	$V_o$		100		mV
			2.5	2.8	3.1	V
Output current capability		$I_o$	2.0			mA
Output resistance	$-I_o = 0.5 \text{ mA}$	$R_o$		150		$\Omega$
Reverse voltage at the output	AM switch OFF, $\pm I_o \leq 1 \mu\text{A}$	$V_o$		6		V
<b>Standby switch Pin 2</b>						
Switching voltage		$V_I$		$4 V_{BE}$ (2.75)		V
Required control voltage	AM-ON AM-OFF	$V_I$ $V_I^{1)}$	3.5		2	V
Input current	AM-ON, $V_2 = 0$	$-I_I$			200	$\mu\text{A}$
	AM-OFF, $V_2 = 12 \text{ V}^{1)}$	$\pm I_I$			10	

1) or open input

## Operating Conditions

$V_S = 8.5 \text{ V}$ ,  $f_{iRF} = 1 \text{ MHz}$ ,  $f_{mod} = 0.4 \text{ kHz}$ ,  $m = 30\%$ ,  $T_{amb} = 25^\circ\text{C}$ , reference point Pin 18 (fig. 2) unless otherwise specified

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
RF input voltage	$(S+N)/N = 6 \text{ dB} = 26 \text{ dB}$ $= 46 \text{ dB}$	$V_{iRF}$		1.5 15 150		$\mu\text{V}$
RF input for AGC operation		$V_{iRF}$		30		$\mu\text{V}$
Control range with ref. to $V_{iRF} = 500 \text{ mV}$	$\Delta V_{oAF} = 6 \text{ dB}$	$\Delta V_{iRF}$		87		dB
Maximum RF input voltage	$d = 3\%$ , $m = 80\%$ $d = 3\%$ , $m = 30\%$ $d = 10\%$ , $m = 30\%$	$V_{iRF}$		0.5 0.7 0.9		V
Audio output voltage	$V_i = 1 \text{ mV}$ Pin 6 $V_i = 4 \mu\text{V}$ , $m = 0.8$	$V_{oAF}$		310 75		mV
RF input voltage	$V_{oAF} = 60 \text{ mV}$	$V_{iRF}$	2	5.5	9	$\mu\text{V}$
Total distortion of audio output voltage	$m = 80\%$ , $V_i = 1 \text{ mV}$ $m = 30\%$ , $V_i = 500 \text{ mV}$	d		0.7 0.9		%
Signal plus noise to noise ratio of audio output voltage	$V_i = 100 \text{ mV}$	$(S+N)/N$		56		dB
IF bandwidth ( $-3 \text{ dB}$ )		$B_{IF}$		4.6		kHz
IF selectivity	$\Delta f = \pm 9 \text{ kHz}$ $\Delta f = \pm 36 \text{ kHz}$	$S_{IF}$		30 60		dB

## Test Circuit

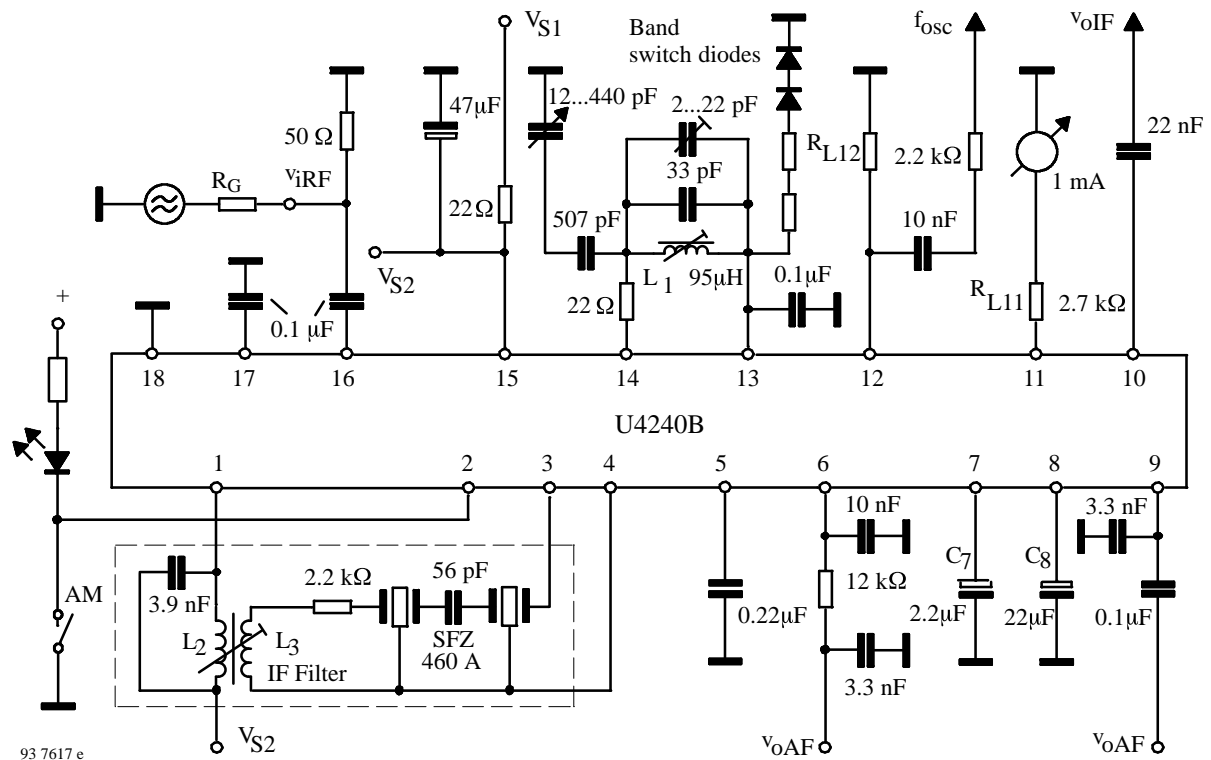
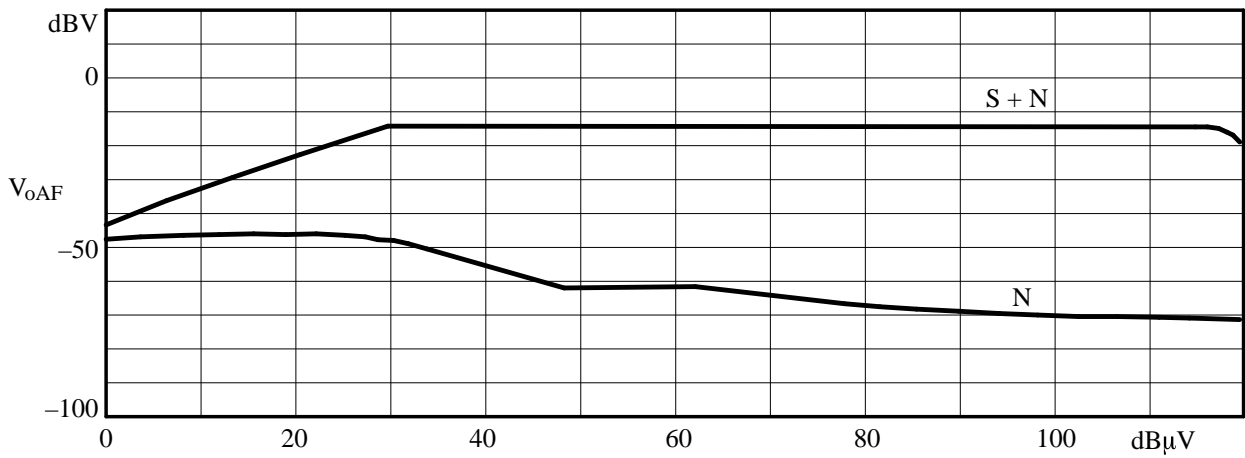
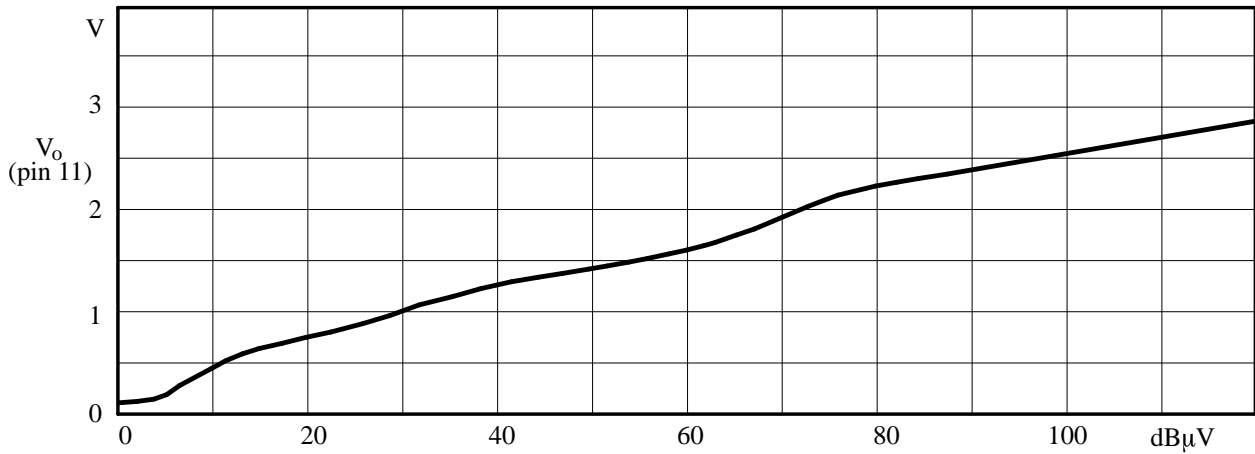


Figure 2.



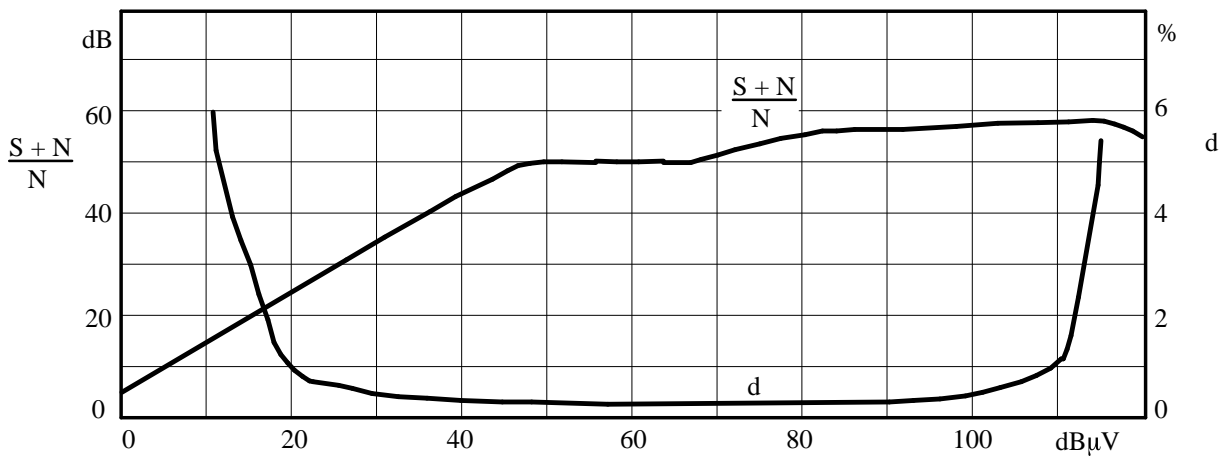
$V_{iRF}$

93 7736 e



$V_{iRF}$

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$V_{iRF}$

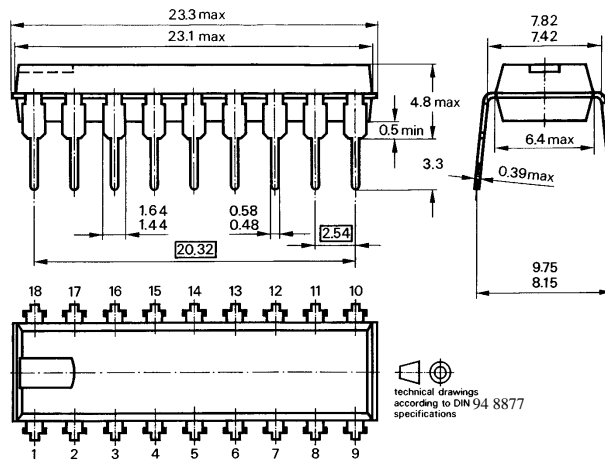
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## Ordering and Package Information

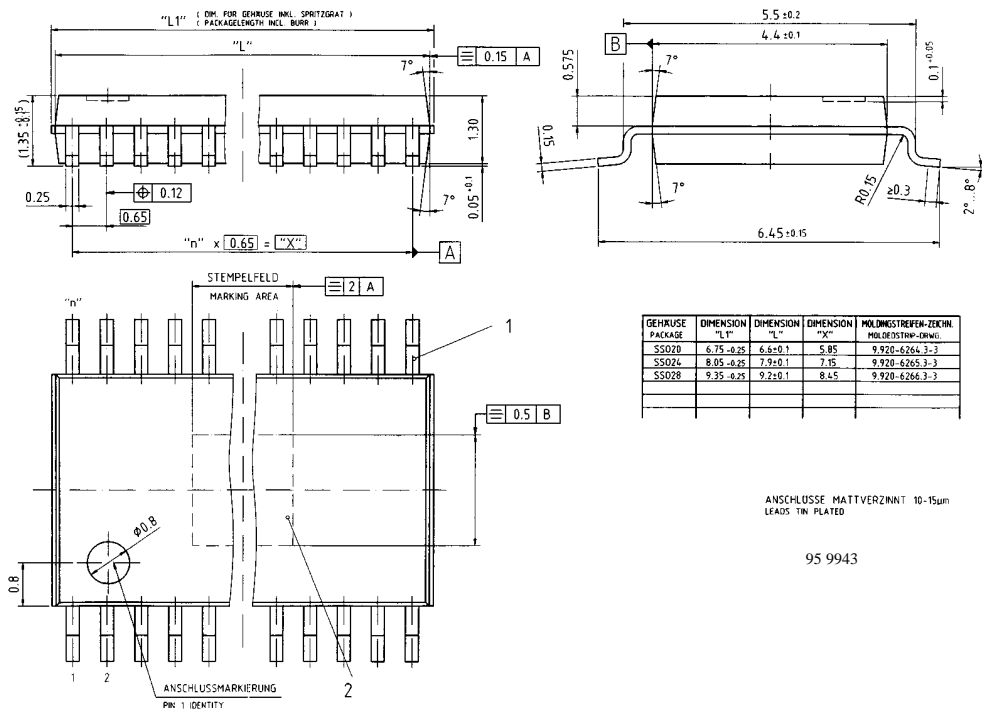
Extended type number	Package
U4240B-A	18 pin DIP plastic
U4240B-AFS	SSO 20 plastic

## Dimensions in mm

Package: DIP 18



Package: SSO 20



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2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

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2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA
3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

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